LIONS Monitor

Individuals' Perspectives on Information Technology and E-Signatures

LIONS

LIONS

LIONS RESEARCH PROJECT

LEDGER INNOVATION AND OPERATION NETWORK FOR SOVEREIGNTY

The interdisciplinary research project LIONS establishes a research platform for the exploration of distributed ledger technology as a digitalization technology to increase resilience and digital sovereignty.

LIONS develops technical and analytical competencies, provides a laboratory environment with infrastructure for DLT of realistic size, and is building a community from the Bundeswehr, government agencies, and the private sector. Indicators and tools for analysis, design, and implementation of DLT-based information systems and their contribution to resilience and digital sovereignty are developed, taking into account three perspectives of analysis: (1) state or supranational institution, (2) organization, and (3) individual.

The project is funded by dtec.bw – Digitalization and Technology Research Center of the Bundeswehr. dtec.bw is funded by the European Union – NextGenerationEU.

To learn more about the project, visit the LIONS homepage at:

https://www.unibw.de/lions

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PREFACE

Dear Reader,

Sovereignty is the promise to act confidently in the digital space. Increasing the digital sovereignty of states or supranational institutions, organizations, and the individual is the objective of the LIONS research project. We develop concepts to analyze and increase digital sovereignty, and we build technologies to support that goal. Our research perceives the individual as a key to more digital sovereignty.

Digital identities, digital wallets, and electronic signatures are enablers for digital sovereignty as they facilitate data management, authorization of transactions and all kinds of digital asset management. Our design principle is to design in a distributed, decentralized architecture to empower the individual users.

What does it take to build a digital infrastructure for more digital sovereignty? To answer that, it is also crucial, to understand the perspective of the individuals, who are using information technology.

Therefore, this Monitor study addresses the topic of digital sovereignty from the perspective of the individual. The focus is on technology readiness, the use of information technology, and on the use of electronic signatures as an example of information systems relevant for individuals.

The survey was rolled out to participants from Germany through a third party. The questionnaire was designed in spring 2024. The online survey took place from April to May 2024. 1616 respondents took part in the survey, 1024 of which completed the questionnaire.

This study continues the Monitor series, which originated in the VeSiKi and Nutri-Safe projects, with the Monitor studies on information security of critical infrastructures, the NutriSafe Monitor on Resilience and Blockchain Technology in Food Production and Logistics, and the previous LIONS Monitor on resilience and digital sovereignty in organizations.

This study is conducted by the LIONS research project. We would like to thank the participants in this survey, and, above all, dtec.bw for funding the LIONS project.

Prof. Dr. Ulrike Lechner

LIONS project lead and und Professor at the University of the Bundeswehr in Munich

CONTENTS

SURVEY PARTICIPANTS

The study participants are a cross-section of the German population. They provide information on how modern technologies affect them and how ready they are to use them.

The online survey was conducted from April to May 2024 with 1343 participants (after cleansing of invalid records), 1024 of whom completed the questionnaire. The analysis in this monitor is based on these 1024 data records. All participants are located in Germany.

School education was mostly high: 41% had a high level of education with 12 or more years of schooling (German Abitur), almost 40% had a medium educational level with 10 years of schooling, and approximately 19% had a lower educational level, with 9 or fewer years of schooling.

Familiy status

Married/
Reg. Partnership
44.4 %

Divorced/
Partnership
annuled
10.8 %

Separated
1.7 %

Widowed
1.8 %

No response
0,5 %

Single
40.8 %

Gender

Female
50.9 %

Male
48.7 %

Diverse
0.4 %

Education

Low
19,3%

Medium
39.6 %

High
41.1 %
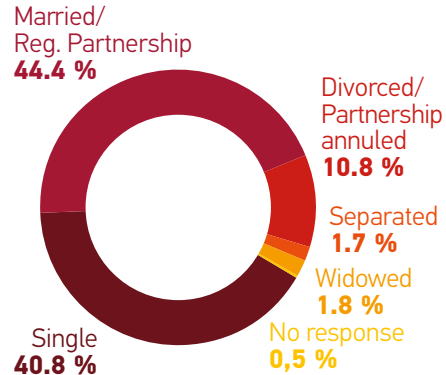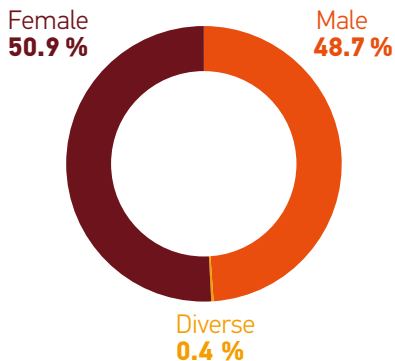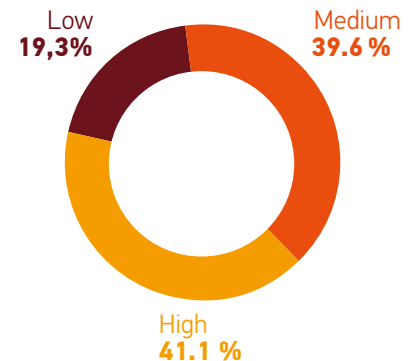
USE OF INFORMATION TECHNOLOGY

PARTICIPANTS PREFERENCES

To gain a comprehensive understanding of the platforms on which participants access and interact with digital information systems, the study asked respondents to share their preferences for both mobile and desktop operating systems. This inquiry aimed to identify the devices and environments most commonly used for engaging with digital content.

The results revealed a clear trend: the majority of participants prefer Android as their mobile operating system and Windows for desktop use. These findings suggest that, despite the wide range of options available, such as iOS and macOS, users tend to gravitate toward the more universally accessible and widely adopted systems. It is known that Android's prevalence on mobile devices is likely due to its affordability and compatibility with a wide range of hardware, making it an attractive option for many users. Windows, similarly, remains dominant in the desktop environment.

Preferred operating system for mobile devices
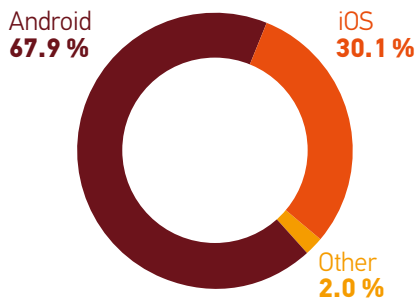
Preferred operating system for desktop devices

Android
67.9 %

iOS
30.1 %

Other
2.0 %

Windows
87.4 %

MacOS
10.2 %

Linux
2.4 %
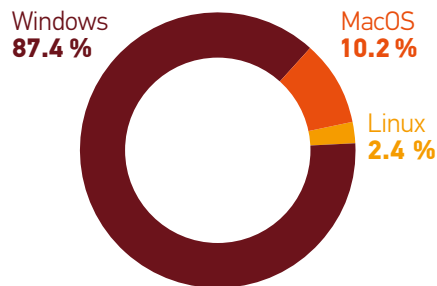
TECHNOLOGY COMMITMENT

Technology commitment (Neyer et al., 2012) describes individual differences in the willingness of technology use through three distinct facets: technology acceptance, technology competence convictions, and technology control convictions.

Technology acceptance relates to personal interest in new technologies, technology competence convictions refer to an individual's self-confidence and belief in their personal ability to use technology effectively, and technology control convictions address an individual's perception of the extent to which technology is controllable.

Technology commitment is considered to predict the use of new technologies, especially for older adults.

Technology commitment groups

high
16.7 %

medium
69.1 %

score
3.45
(scale 1 to 5)

low
14.2 %
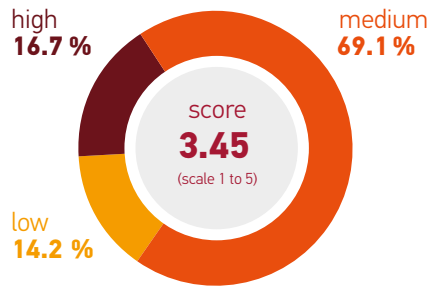
Technology commitment by level of education

	low tech. readyness	medium tech. readyness	high tech. readyness
High education	7.1	71.3	14.0
Medium education	13.2	55.3	31.5
low education	24.5	61.5	21.6

in % 0 10 20 30 40 50 60 70 80 90 100

Technology acceptance

If I had the opportunity, I would use technical products much more often than I currently do.
9.5 | 19.6 | 35.0 | 25.9 | 10.1

I quickly take a liking to new technical developments.
5.0 | 12.9 | 35.4 | 31.2 | 15.5

I am very curious about new technical developments.
6.4 | 13.7 | 30.6 | 32.7 | 16.6

I am always interested in using the newest technical devices.
11.8 | 18.3 | 33.6 | 24.5 | 11.8

Technology competence convictions

I'm often afraid of failing when dealing with modern technology.
3.7 | 12.0 | 25.0 | 31.4 | 27.8

For me, dealing with technical innovations is usually too much of a challenge.
3.6 | 11.6 | 23.7 | 28.0 | 33.0

I'm afraid of breaking new technical products rather than using them properly.
4.8 | 11.8 | 27.9 | 31.5 | 23.9

I find dealing with technology difficult – I just can't handle it in most cases.
2.8 | 13.1 | 23.9 | 30.3 | 29.9

Technology control convictions

Whether I am successful in using modern technology essentially depends on me.
2.3 | 8.5 | 33.4 | 39.6 | 16.1

If I have difficulties with technology, it is ultimately up to me to solve them.
6.3 | 14.8 | 42.1 | 27.8 | 8.9

It is up to me whether I succeed in using new technical developments – it has little to do with chance or luck.
2.9 | 9.8 | 32.0 | 39.2 | 16.1

What happens when I deal with new technical developments is entirely under my control.
3.7 | 11.5 | 35.3 | 36.5 | 13.0

in % 0 10 20 30 40 50 60 70 80 90 100

■ not true at all ■ little true ■ partly true ■ quite true ■ completely true

IMPORTANCE OF INFORMATION TECHNOLOGY

The participants were asked to assess the impact of information technologies on their professional progression. Around half of them consider these technologies to be relevant in helping them grow in their careers. This suggests that for many, digital tools play an important role in improving job performance and opening up new opportunities. However, it also indicates, that a significant portion of participants do not view information technologies as a major factor in their professional progress.

Dealing with IT is relevant for my professional progression...

I don't know
9.2 %

no answer
2.9 %

no
37.4 %

yes
50.5 %
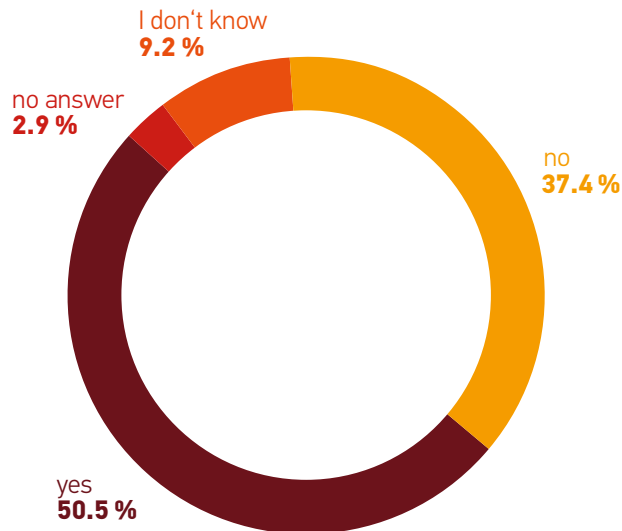
INTERNET USERS' INFORMATION PRIVACY CONCERNS

These charts illustrate the significance participants place on different aspects of data privacy, using the question set of Malhotra et al. (2004). Notably, the transparency of how online companies handle and process personal data stands out as particularly important to them. This reflects a clear concern among participants for greater visibility and accountability in how their information is managed by digital platforms.

Control

Consumer control of personal information lies at the heart of consumer privacy.
1.3 | 2.1 | 7.3 | 19.8 | 17.7 | 25.4 | 26.5

Consumer online privacy is really a matter of consumers' right to exercise control and autonomy over decisions about how their information is collected, used, and shared.
1.8 | 2.8 | 8.4 | 31.0 | 16.3 | 21.8 | 18.0

Awareness of privacy practices

A good online privacy policy should have a clear and conspicuous disclosure.
2.1 | 3.0 | 6.2 | 13.4 | 10.4 | 21.6 | 43.5

Companies seeking information online should disclose the way the data are collected, processed, and used.
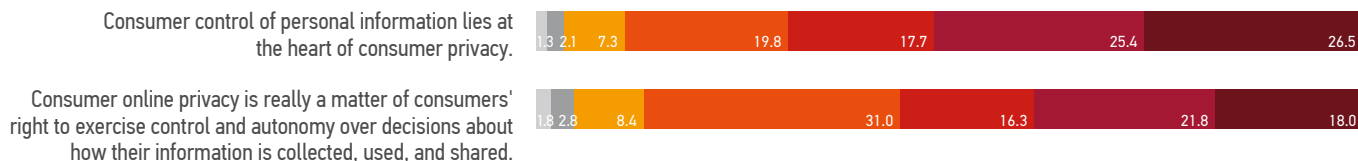2.1 | 2.4 | 5.8 | 13.8 | 9.5 | 21.7 | 44.8

Collection

I'm concerned that online companies are collecting too much personal information about me.
3.4 | 5.3 | 8.5 | 21.1 | 17.6 | 21.1 | 23.0

It bothers me to give personal information to so many online companies.
3.1 | 5.7 | 10.5 | 20.2 | 18.5 | 19.5 | 22.5

When online companies ask me for personal information, I sometimes think twice before providing it.
2.6 | 3.5 | 7.9 | 20.3 | 19.1 | 22.5 | 24.0

It usually bothers me when online companies ask me for personal information.
3.6 | 5.2 | 12.2 | 26.8 | 18.6 | 19.1 | 14.6

in % | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100

■ not true at all ■ not true ■ little true ■ partly true ■ quite true ■ true ■ completely true
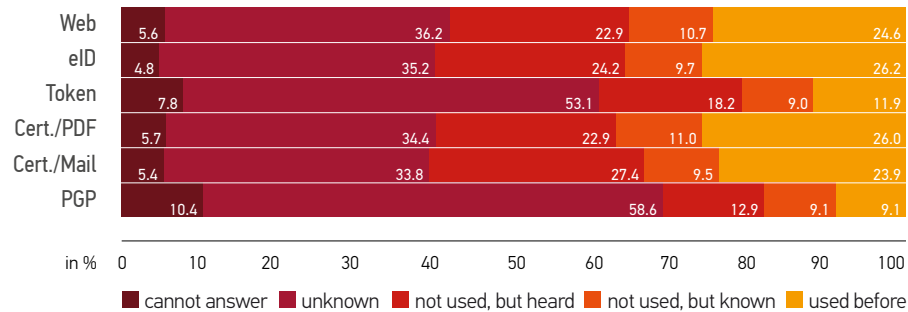
ELECTRONIC SIGNATURES

SIGNATURE METHODS

There are several methods available for electronically signing documents or data. Participants in the study were asked about six different systems. One popular option is the use of web services, which allow documents to be signed conveniently through a browser. Another is the use of a digital passport (eID), often required for official services. Hardware-based systems, such as tokens, are also an option. Digital certificates are commonly used for signing emails or PDF files. A less familiar method are PGP applications, which rely on asymmetric cryptography. However, most participants are not very familiar with these systems. For many, they are even completely unknown.

Familiarity of electronic signature methods

	cannot answer	unknown	not used, but heard	not used, but known	used before
Web	5.6	36.2	22.9	10.7	24.6
eID	4.8	35.2	24.2	9.7	26.2
Token	7.8	53.1	18.2	9.0	11.9
Cert./PDF	5.7	34.4	22.9	11.0	26.0
Cert./Mail	5.4	33.8	27.4	9.5	23.9
PGP	10.4	58.6	12.9	9.1	9.1

WHY NOT USED YET?

If participants were familiar with a system but had not used it yet, they were asked to state the reason by selecting an option. A clear trend emerged: the majority chose not to use these systems, either because they found them too complicated, or because they did not understand how they worked. Still, many reasons remain unclear.

Reasons for not having used electronic signature methods yet

|	I haven't needed yet	I don't want to use it because I don't understand it	I don't want to use it because it's too complicated for me	other reason
Web	8.4	28.2	30.9	32.5
eID	7.9	29.5	30.7	31.9
Token	6.9	29.6	30.7	32.8
Cert./PDF	6.1	30.3	31.0	32.8
Cert./Mail	6.8	29.7	31.1	32.4
PGP	11.4	27.8	29.1	31.6

in %
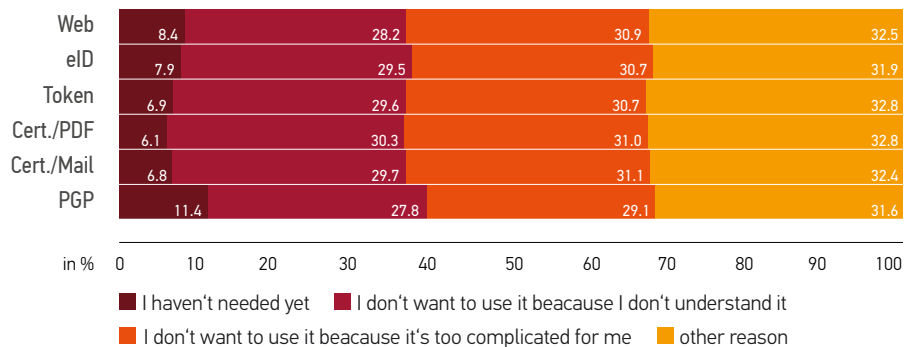
USABILITY OF SIGNATURE METHODS

If participants were familiar with a system, they were asked to evaluate its usability. To do this, established question sets (Brooke, 1996) were used, and a score between 0 and 100 was calculated. A score below 50 is deemed unacceptable – most systems only slightly surpassed this threshold. When participants were grouped by education level, the results showed little variation. However, when grouped by their commitment to technology, a clear pattern emerged: participants with a more positive attitude towards technology tended to rate the usability of these systems more favorably.

Low education
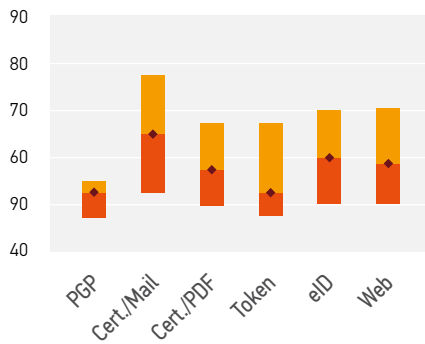
Medium education
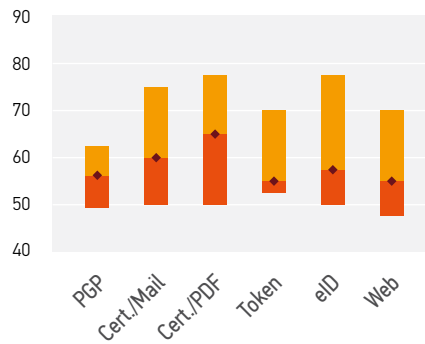
High education

■ median ■ lower quartile to median ■ median to upper quartile

Low technology commitment

Medium technology commitment

High technology commitment

■ median ■ lower quartile to median ■ median to upper quartile

TRUST ON SIGNATURE METHODS

Participants familiar with a system were also asked to evaluate their level of trust in it. As with usability, established question sets (Jian et al., 2000) were used to calculate a score ranging from 0 to 100. The education level (page 9) is only associated with trust in the case of PGP. However, a participant's commitment to technology has a significant impact on their trust across all systems, with those more engaged in technology showing notably higher levels of confidence in the systems.
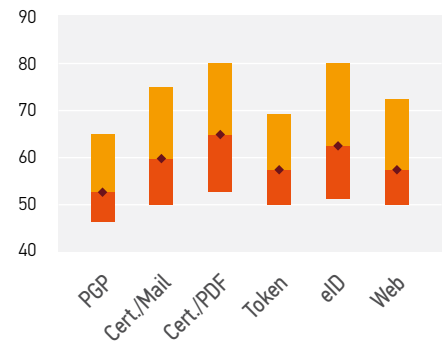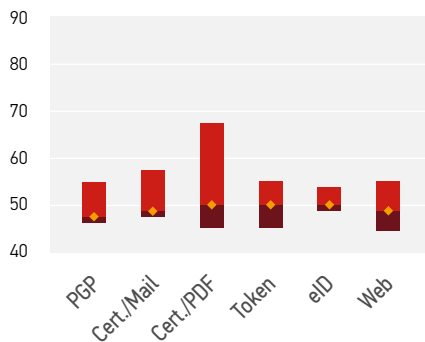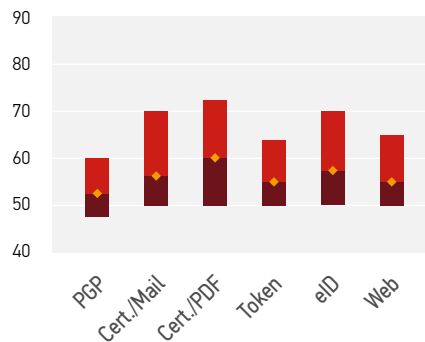
Low education

Medium education

High education

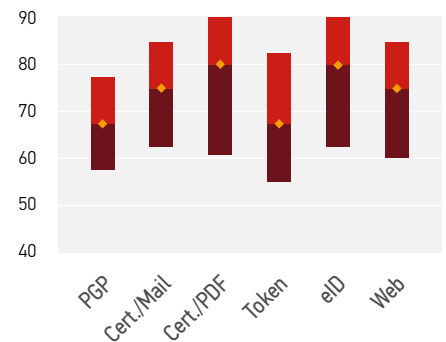■ median ■ lower quartile to median ■ median to upper quartile

Low technology commitment

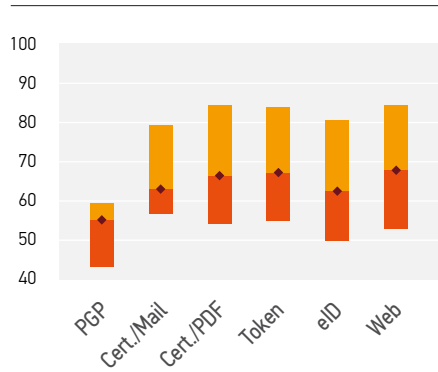### Medium technology commitment

High technology commitment

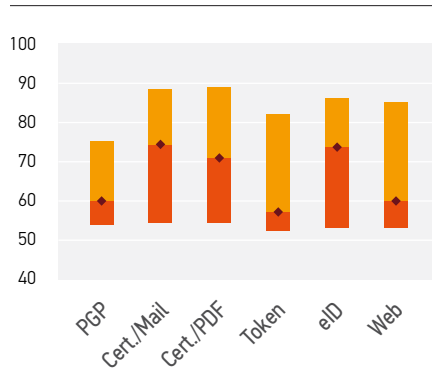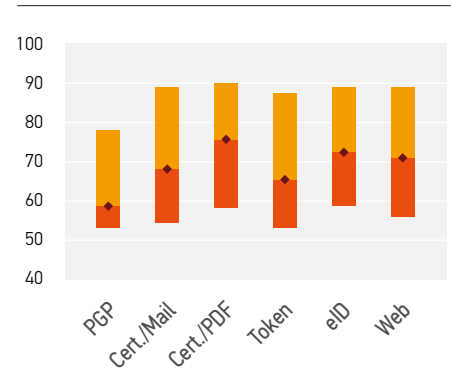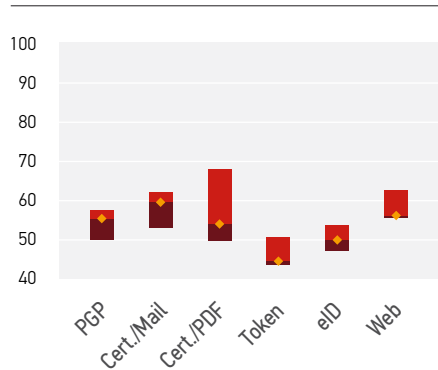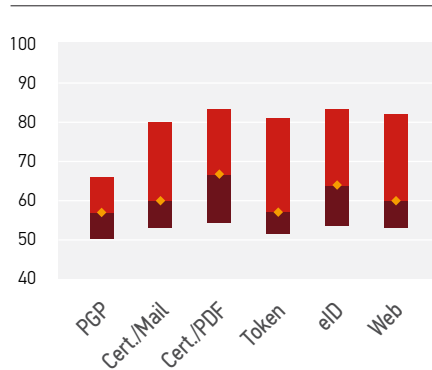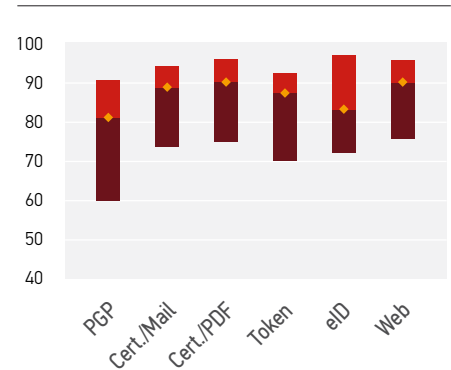■ median ■ lower quartile to median ■ median to upper quartile

USE OF QR CODES

Looking ahead to future system designs, the study examined the acceptance of using QR codes combined with URLs (links) as placeholders for signatures. By clicking on these links or scanning the QR codes, users can either access the signature information or, if no signature has yet been submitted under that link, have the option to provide their own signature. This method allows for a streamlined and flexible approach to digital signatures.

Use of QR codes as placeholders for signatures

Statement	not true at all	little true	partly true	quite true	completely true
I wouldn't want to use it because I see some disadvantages.	14.4	25.0	37.4	14.3	9.0
I still don't see any particular advantages for me.	11.3	19.0	37.9	19.5	12.2
I am unsure whether the requirement for an Internet connection is feasible.	11.9	22.8	37.7	19.3	8.3
I think it would be good being able to distribute to several signatories at the same time	5.5	8.8	36.3	32.3	17.1
I think it would be better to be able to see the signature immediately and without clicking/scanning.	4.4	10.1	34.1	31.2	20.3
I think it would be good to no longer have to print out documents signed with a link and QR code.	6.8	7.7	33.5	29.6	22.4

in % 0 10 20 30 40 50 60 70 80 90 100

■ not true at all ■ little true ■ partly true ■ quite true ■ completely true

BLOCKCHAIN TECHNOLOGY

PERCEPTIONS OF BLOCKCHAIN

Blockchain technology is a decentralized, digital registry that stores transactions in a chronological chain. It is secure, because every transaction is 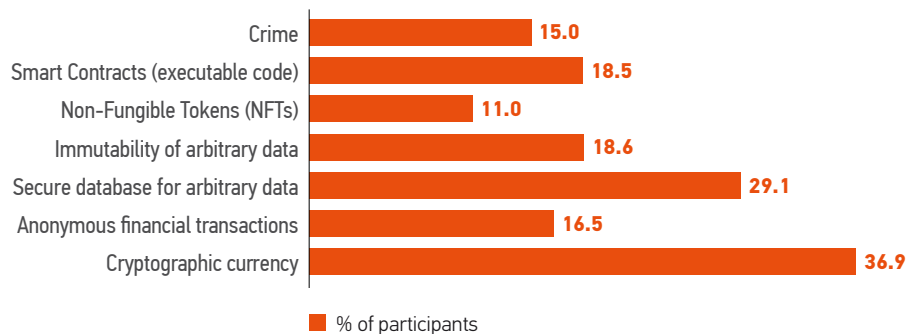protected by cryptographic methods and unchangeable. This structure enables transparent and trustworthy transactions without a central authority. Therefore, it is also the foundation of, e.g., cryptocurrencies.

This chart shows how many participants associate the term "blockchain" with each of the following terms. The participants had to decide for each term individually whether they see a connection. This shows, that the majority of participants make no connection between the term "blockchain" and the term "cryptocurrency", which suggests that many people might not be aware of the technological basis of cryptocurrencies.

Associations with the term "blockchain"

Term	% of participants
Crime	15.0
Smart Contracts (executable code)	18.5
Non-Fungible Tokens (NFTs)	11.0
Immutability of arbitrary data	18.6
Secure database for arbitrary data	29.1
Anonymous financial transactions	16.5
Cryptographic currency	36.9

■ % of participants
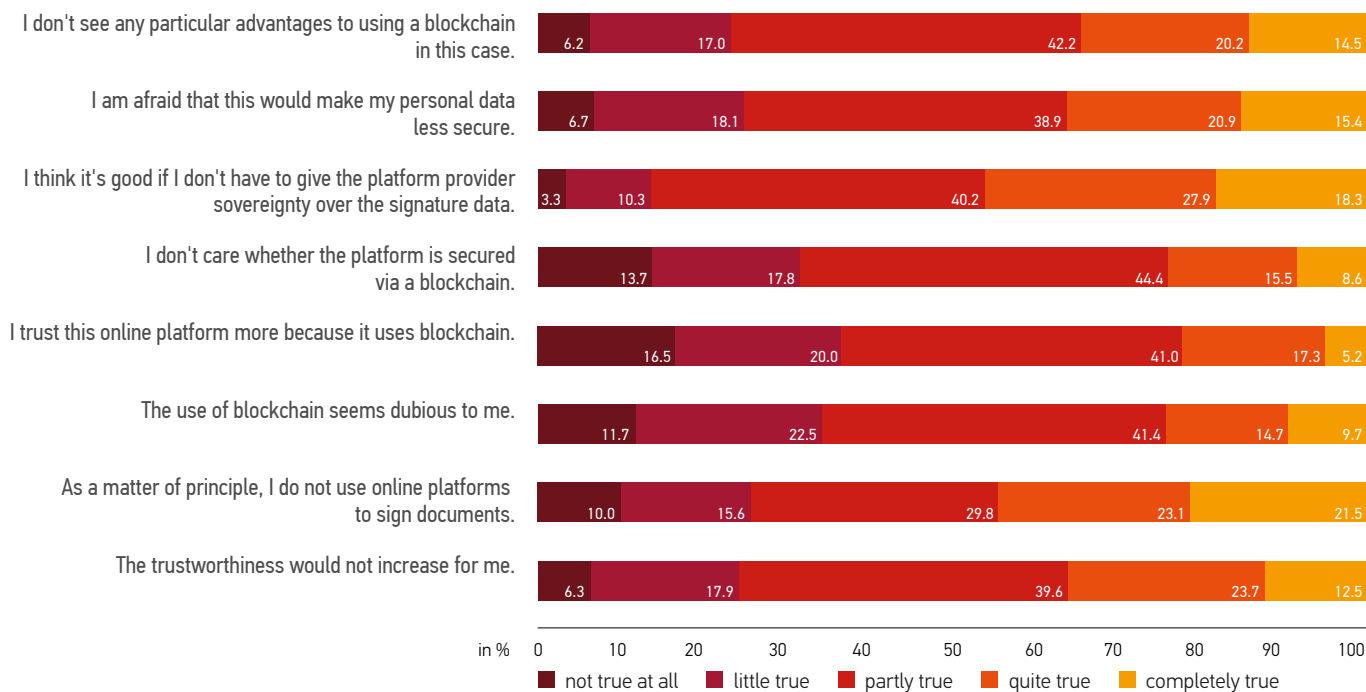
INFLUENCE ON TRUST

The principle of blockchain technology increases the trustworthiness of systems by decentralizing the truth of the data. However, the impact this has on the end user is also to be considered when implementing a blockchain into a system. In particular, the question of whether this increases the subjective trustworthiness is interesting and important. A look at the results shows that the influence on the end users' perceptions is rather limited.

Use of blockchain technology to prevent forgery of signature data on online signature platforms

	not true at all	little true	partly true	quite true	completely true
I don't see any particular advantages to using a blockchain in this case.	6.2	17.0	42.2	20.2	14.5
I am afraid that this would make my personal data less secure.	6.7	18.1	38.9	20.9	15.4
I think it's good if I don't have to give the platform provider sovereignty over the signature data.	3.3	10.3	40.2	27.9	18.3
I don't care whether the platform is secured via a blockchain.	13.7	17.8	44.4	15.5	8.6
I trust this online platform more because it uses blockchain.	16.5	20.0	41.0	17.3	5.2
The use of blockchain seems dubious to me.	11.7	22.5	41.4	14.7	9.7
As a matter of principle, I do not use online platforms to sign documents.	10.0	15.6	29.8	23.1	21.5
The trustworthiness would not increase for me.	6.3	17.9	39.6	23.7	12.5

in %

CONCLUSION

This study, conducted with a diverse sample of the German population, provides valuable insights into technology use and attitudes. The preference for Android and Windows highlights their dominance in mobile and desktop environments. Technology commitment plays an important role in how participants perceive and use digital tools, with many acknowledging the role of technology in professional advancement.

Data privacy is a major concern, with participants prioritizing transparency in data handling by online platforms. The study also revealed varying familiarity with electronic signature methods, showing that web services, digital passports, and the use of digital certificates are well-known, whereas PGP remains less familiar. Usability and trust in these systems are associated with participants' commitment to technology.

Innovative approaches like QR codes for signatures were explored, offering a flexible method for digital transactions. Despite blockchain technology's promise of security and transparency, its impact on user trust remains limited. Overall, the study underscores the importance of making digital technologies more accessible and understandable to enhance user engagement and trust.

ACKNOWLEDGEMENTS

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https://www.unibw.de/lions

A digital version of this report is available at

https://www.unibw.de/lions/monitor

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